a nanoscale gold band that can be functionalized with alkanethiols to be hydrophobic. We describe nanoscale electrical measurements with these post-electrodes on cells and demonstrate Giga-ohm seal formation at the electrode-membrane interface. Moreover, we use coarse-grained molecular dynamics simulations to elucidate the mechanism and structures of electrode-membrane interface formation.

3463-Pos
Characterizing the Structure and Dynamics of Nanodisc Lipid Bilayers of Different Compositions
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One of the key roles of the cellular membrane is the regulation and activation of membrane-anchoring proteins. The lipid composition of the membrane and the ionic content of the immediate solution significantly modify structural properties of the bilayer surface. Nanodiscs are lipoprotein particles of precisely controlled size and composition that proved to be valuable in experimental studies of protein-membrane interactions, for example in studying membrane binding and activation of blood coagulation factors. The enzymatic activity of several coagulation factors is regulated by their binding to anioic regions of the cellular membrane. Nanodiscs consist of a patch of lipid bilayer encircled in a belt-like fashion by a pair of amphipathic helical membrane scaffold proteins (MSP) and can serve as a membrane model. The structure and dynamics of lipid molecules in Nanodiscs are highly relevant to their physicochemical properties, and to the mode of interaction between Nanodiscs and membrane-anchoring proteins and peptides. We employ molecular dynamics simulations to investigate these aspects in solvated Nanodiscs. Extended simulations (on the order of 10s of nanoseconds) with Nanodiscs including anionic phosphatidylserine (POPS), zwitterionic phospatidylcholine (POPC), or POPS/POPC binary mixtures provide for detailed analysis of structural changes that occur due to lipid-lipid and lipid-ion interactions. The methodology supplies us with the atomic level description sufficient to investigate whether MSP influences the boundary lipids. Simulations revealed stable particles of consistent geometry. Presence of divalent cations Ca2+ shows its coordination with lipid head groups and modulates their orientation in the membrane bilayer, thus, preparing the stage for interaction with proteins.

3464-Pos
Inter-Membrane Adhesion Mediated by Mobile Linkers: Effect of Receptor Shortage
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Cell adhesion is a complex process essential for life. It is mediated by specific binding between cell surface proteins that eventually cluster and form supramolecular structures. However, the initial steps of cell adhesion, where physical forces can be expected to dominate over active processes, are barely understood.
Aiming at a rigorous analysis of the physical effects induced by membrane adhesion we developed a simplified passive model system. It consisted of a giant unilamellar vesicle (GUV) adhering via specific biotin-neutravidin interactions to a supported lipid bilayer (SLB). Receptors and ligands diffused freely within the plane of the respective membrane. A new microscopy set-up was developed enabling simultaneous imaging by reflection interference contrast microscopy (RICM) and fluorescence microscopy as well as determination of molecular diffusion by continuous photobleaching.
At high receptor concentrations we found GUV adhesion changed SLB fluidity as well as receptor mobility and distribution. The adhering membrane caused homogeneous accumulation and immobilization of the initially mobile receptors. Due to the introduction of these obstacles in the SLB its fluidity decreased significantly as well. Friction to the tightly bound GUV membrane furthermore enhanced the reduction of SLB fluidity.
At low receptor concentrations a characteristic ring-like accumulation pattern emerged. Due to the low efficiency of receptor diffusion at large distances receptors were accumulated only at the edge of the adhering GUV. In addition, GUV adhesion was found to be incomplete. The balance between the loss of translational entropy of the receptors and the gain in Gibbs'free enthalpy by receptor-ligand binding determined the final adhesion state.
The present results suggest that in addition to employing different receptor/ligand pairs, cells may regulate cell-cell adhesion by careful control of the receptor surface concentration.

3465-Pos
Collective Membrane Dynamics under Osmotic Stress
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Phospholipid membranes are highly dynamic, ordered structures that involve molecular motions of phospholipids together with collective fluctuations of the bilayer [1]. Membrane structural dynamics on these length scales are sensitive to changes in properties such as temperature, pressure, and chemical potential. Structural deformation accompanying the removal of water from the membrane is well characterized, yet perturbation of membrane dynamics under osmotic stress conditions has not been studied. Here we show that membrane dynamics as revealed by ^{2}H NMR relaxation measurements are sensitive to osmotic stress. Specifically, we measured the segmental order parameters (S_{CD}) and ^{2}H spin-lattice relaxation rates (R_{1Z}) over a broad range of hydration levels. Empirical correlations of acyl chain S_{CD} and R_{1Z} profiles follow a theoretically predicted square-law functional dependence. However, for a given acyl position R_{1Z} is essentially independent of S_{CD} as the hydration water is varied. This is expected if the correlation length of the collective and segmental fluctuations remains unperturbed. The fast segmental fluctuations are decoupled from larger amplitude lipid motions within the osmotically stressed membrane. This result contrasts with studies involving cholesterol, where variations of S_{CD} on the order of those observed in the osmotic stress experiment lead to significant reductions in R_{1Z} rates [2]. In this case, interaction with cholesterol couples local segmental dynamics to collective viscoelastic modes. These results show that the relation of S_{CD} to R_{1Z} is a characteristic marker of lipid matrix composition and collective lipid interactions. Furthermore, our results highlight intrinsic differences in the sensitivity of membrane dynamics, as may be encountered for peripheral protein-membrane interactions and integral membrane-lipid interactions. [1] M.F. Brown and S.I. Chan, *Encyclopedia of Nuclear Magnetic Resonance*, Wiley, New York 1996, 871-885. [2] G.V. Martinez *et al.* (2004) *Langmuir* **20**,1043-1046.

3466-Pos
Differential Effect of Isoflurane on the Anisotropy of Diphenylhexatriene and its Cationic Trimethylamine Analog
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The mechanism of action of volatile general anesthetics has not yet been resolved. Recent developments in the understanding of lipid physics, including the discovery of microdomains and computing the lateral pressure profile in simulations, suggest a need to revisit possible indirect effects of lipids on ion channels during anesthesia. We present strong experimental evidence that volatile general anesthetics localize at the headgroup region of a lipid bilayer and therefore increase lateral membrane pressure near the bilayer surface. Theoretically, this increase in pressure in the head group region, in conjunction with a decrease in pressure in the tail group region, may induce conformational changes in ion channels to produce the characteristic effects of volatile general anesthetics. To examine this idea, the anisotropy of fluorophores localized in either the head (trimethylamino-diphenylhexatriene, TMA-DPH) or tail group regions (DPH) of small unilamellar vesicles of dipalmitoylphosphatidylcholine was assessed. These measurements were repeated at multiple temperatures between 20 and 55 °C in the presence or absence of various concentrations of the anesthetic isoflurane. In treated samples, the main phase transition (41.5 °C) was shifted down by 2 to 10 °C depending on the concentration of isoflurane (3.8-13.0 mM). Melting reduced anisotropy by 0.1 (TMA-DPH) or 0.2 (DPH) units. Interestingly, isoflurane caused opposite changes in anisotropy of the two probes in the liquid crystalline phase: DPH anisotropy decreased by ~0.02 units whereas TMA-DPH anisotropy increased by the same magnitude. This observation suggests that isoflurane partitions into the headgroup region of the bilayer where it increases lateral pressure, while reducing it in the tail region.

3467-Pos
Deformation of Vesicles Controlled by Local Spontaneous Curvatures of Membrane
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The metabolic pathways are fundamental processes to maintain the life, which is supported by the cell membrane deformations such as, membrane adhesion, fusion and pore formation. In the present living organisms, the membrane